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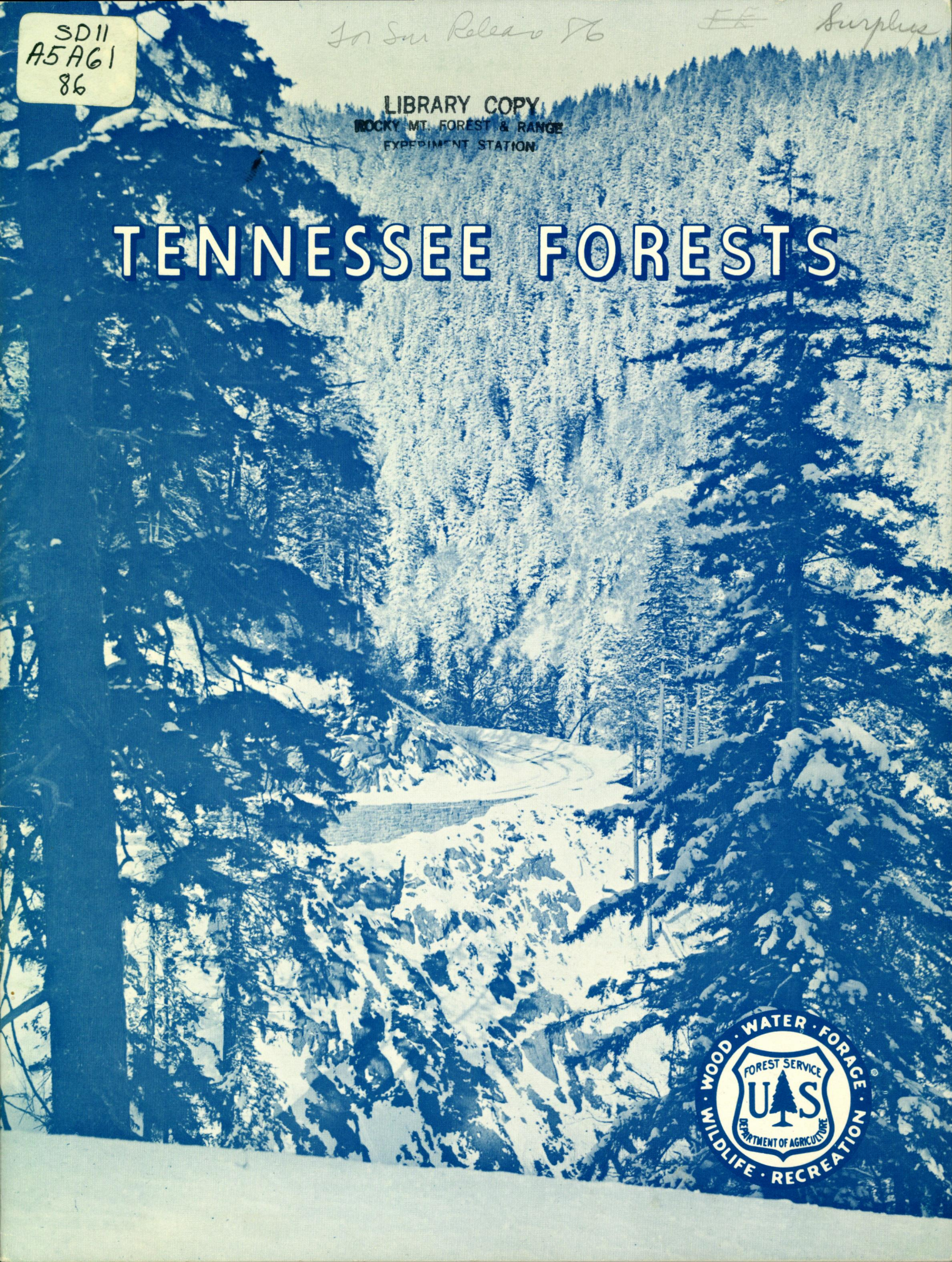

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DEPARTMENT OF AGRICULTURE

Foreword

This report presents the principal findings of the second Forest Survey of Tennessee, made in 1960-61 by the Southern Forest Experiment Station. The survey, which was undertaken as one phase of the nationwide inventory being conducted by the U. S. Forest Service, provides up-to-date information on the kind, amount, and condition of forest resources; the industries they support; and the possibilities for improving wood production. Comparison with the inventory that was completed in 1950 helps to clarify timber trends.

Generous assistance from public and private organizations made it possible to keep the field work for the new inventory ahead of the schedule that could have been maintained with regularly allotted funds. The very material aid of the organizations listed below, and of the individuals in them, is gratefully acknowledged:

Tennessee Valley Authority

Nickey Brothers, Incorporated

Hiwassee Land Company

Tennessee River Pulp and Paper Company

TENNESSEE FORESTS

Herbert S. Sternitzke

U. S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

SOUTHERN FOREST EXPERIMENT STATION
New Orleans, Louisiana

1962

Photos by
Tennessee Conservation Department

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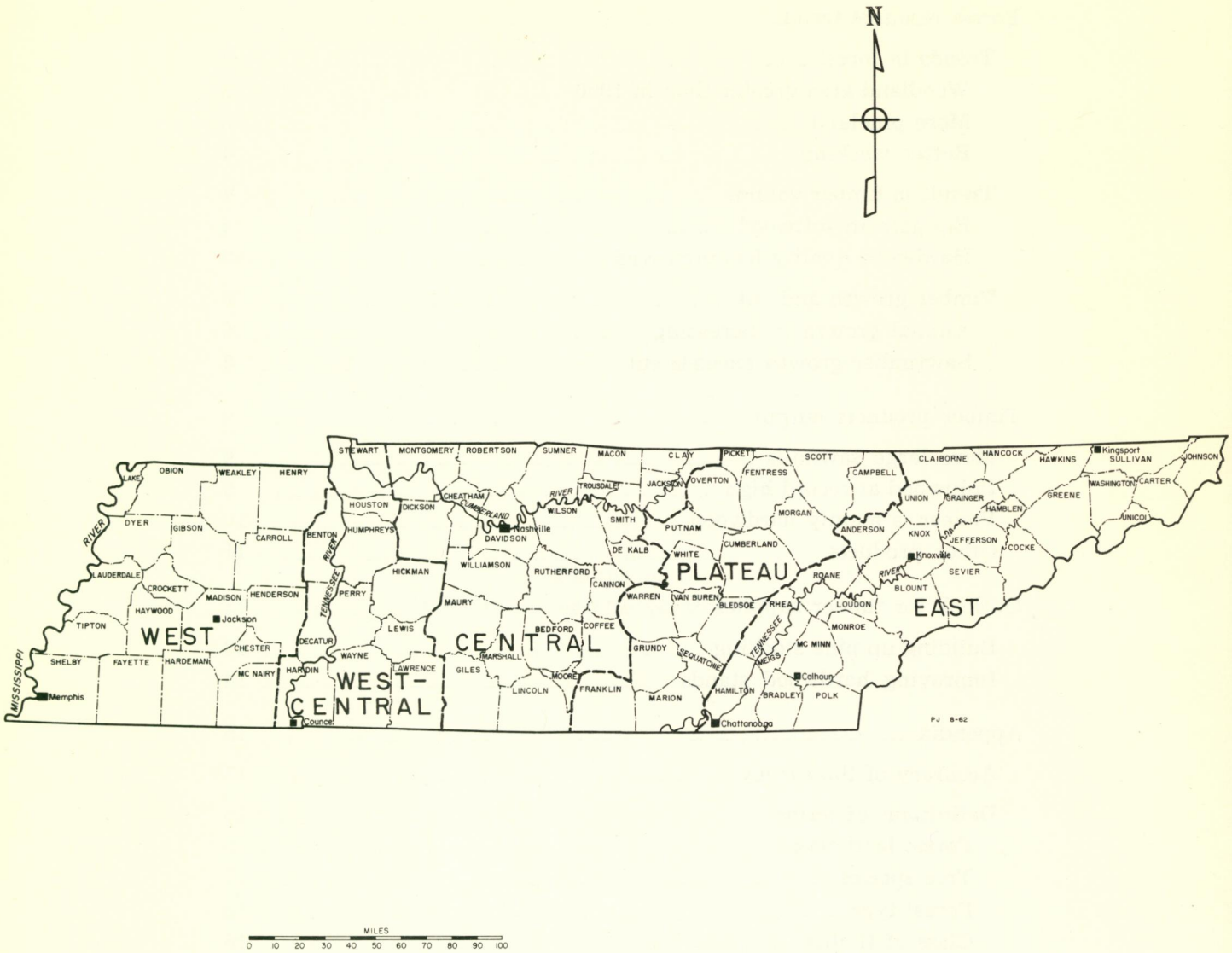


Figure 1. *Forest Survey regions in Tennessee.*

Tennessee Timber Highlights

A new forest survey of Tennessee was completed in 1961. During the years since the earlier survey of 1950, both forest conditions and the timber industry changed considerably.

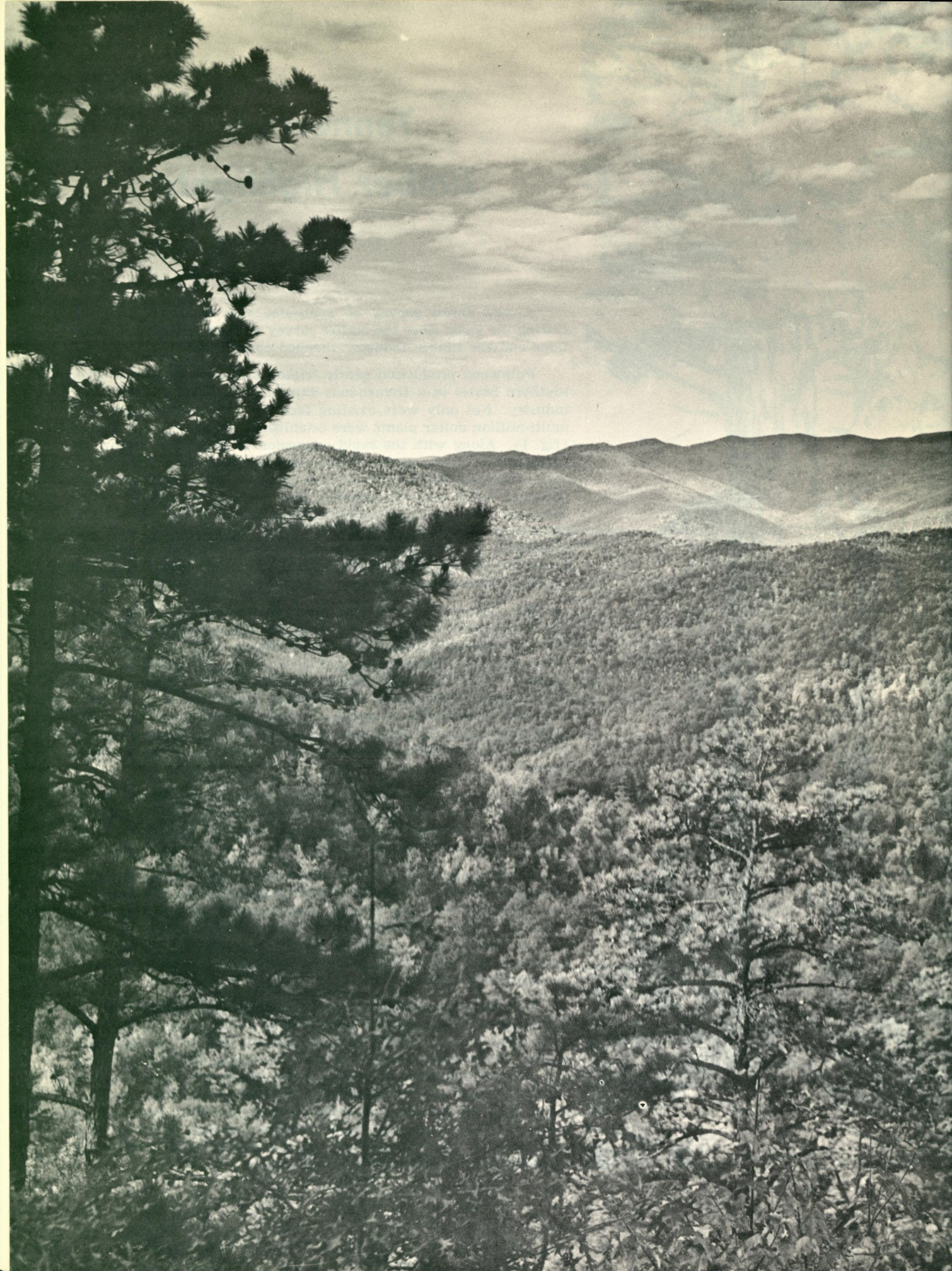
Pulpwood production nearly tripled as Tennessee joined other southern States in a tremendous expansion of the pulp and paper industry. Not only were existing facilities enlarged, but two new multi-million dollar plants were established at Calhoun and Counce (fig. 1). Along with the rapid expansion of pulping facilities, the composition of the annual pulpwood harvest shifted. Today the bulk of the pulpwood output is pine; prior to 1954 it was hardwood. Although many portable sawmills shut down or moved out of the State, the average annual output of those that survived rose sharply; mills cutting in excess of 3 million board feet each year increased in number. Overall, the production of sawlogs, pulpwood, and other industrial roundwood in Tennessee is greater now than at the time of the previous survey.

The outlook for the timber resource has also brightened. Both pine and hardwood sawtimber volumes have increased significantly. The improvement largely reflects ingrowth of young trees into sawtimber sizes, in response partly to better fire protection and partly to improved timber management practices. Forest management programs have been expanded and intensified in many parts of the State, especially on public and industrial holdings. Moreover, both public agencies and forest industries are sponsoring programs of technical assistance to stimulate better practices on small ownerships.

The area of forest land is about a million acres more than in 1950. Woodland acreage now exceeds the area devoted to all other land uses in Tennessee, and there are signs of additional forest acreage gains in the decade ahead.

Other aspects of the forest situation are less encouraging. Several million acres that are capable of growing pine, for example, are dominated by other species. One in every five hardwoods is a cull—a waster of growing space that could be devoted to thrifty timber. The current growth of timber is scarcely a third of the potential. And stocking in many stands is far less than most forest managers might desire.

The greatest possibilities for enhancing forest productivity in Tennessee are in raising the level of pine stocking and in applying stand improvement practices to all sites capable of growing high-quality hardwoods rapidly. The most promising remedial measures are to plant pine sites on which adequate natural regeneration is not likely; to remove culls and other low-value trees that are interfering with the growth or establishment of desirable ones; and, on hardwood lands especially, to plan timber harvests in a way that will insure a build-up in trees of the quality, size, and utility normally demanded for industrial purposes.



Forest Resource Trends

TRENDS IN FOREST AREA

Woodland Area Greater Than In 1950

Forests dominate the Tennessee landscape. All together, they now occupy 52 percent of the State's total land. Commercial forests total over 13.4 million acres. Another 264 thousand wooded acres are reserved from timber cutting. Most of the reserved area—set aside chiefly for recreational use—is in the Great Smoky Mountains.

In 1950 commercial forests made up less than 12.4 million acres. The recent gain in forest area is apparently related to Tennessee's changing farm economy. Land in farms, for example, dropped some 13 percent between 1950 and 1959. At the same time, average farm size rose to 102 acres, a 28-percent increase. In addition to consolidating their holdings, farmers have been releasing from cultivation acreage that is eroding or in other ways submarginal. Woodland on farms increased from 25 to 33 acres per farm during the fifties.

Increases in forest area have been quite general over the State. The smallest regional gain, 4 percent, was in the Cumberland Plateau, which has long been the most heavily wooded section of Tennessee. The largest gain, 14 percent, was in the counties to the east of the Plateau. Statewide, the net effect of land-use shifts is that current forest acreage is 9 percent greater than in 1950 (table I).

Table I.—*Commercial forest land (1961) and change since 1950*

Region	Commercial forest	Change
	Thd. acres	*Percent*
West	1,899.3	+ 6
West-central	2,302.7	+ 9
Central	2,580.5	+ 10
Plateau	3,178.0	+ 4
East	3,471.9	+ 14
Total	13,432.4	+ 9

Associated with land-use changes have been notable shifts in population. Woodland expansion was accompanied by a 7-percent drop in Tennessee's rural population between 1950 and 1960. By contrast, urban areas experienced a 28-percent gain. Implicit in these trends is a better adjustment of people to resources as rural residents seek employment in expanding industrial centers.

Further gains in forest area seem likely. The new survey revealed, for example, that some 750 thousand acres, or 6 percent of the nonforest acreage, is made up of old fields that have been out of cultivation for 5 or more years. It can be reasonably assumed that a fair share of this area will either be planted to trees or else will revert naturally to forest. One recent study [1] estimated that forest acreage in the Tennessee Valley, which encompasses most of the State, might increase by more than one million acres during the next few decades.

More Pineland

Unlike most of the States to the south of it, Tennessee is predominantly a hardwood region. Nearly three-fourths of the commercial forest land is occupied by various upland hardwood types, chiefly oak and hickory in mixture with other species. Southern pine types are found largely in the Cumberland Plateau and in the Great Valley of eastern Tennessee. Bottomland forests are conspicuous only in the extreme western counties that drain into the Mississippi River. Redcedar prevails in the Central Basin.

Between surveys there was some shifting of acreages in the major forest types. The extensive upland hardwood types as well as forests

[1] Forest Resource Trends in the Tennessee Valley. Tenn. Valley Authority, 4 pp. illus. Norris, Tenn. 1961.

in which at least 25 percent of the stand is southern pine each gained 11 percent. Redcedar types dropped 23 percent, mainly because of localized land clearing and heavy cutting of this species from mixed cedar-hardwood stands. Acreage of bottom-land forests remained virtually unchanged (fig. 2).

The modest expansion of acreage supporting southern pines is especially encouraging to the pulp and paper industry, whose use of these species is steadily increasing. Nevertheless, several million additional forest acres that are capable of growing pine are still dominated by low-value hardwoods.

Better Stocking

Forest land in Tennessee is noticeably better stocked today than it was a decade ago. Much of the change is attributable to the improvement and extension of public fire protection. For the 5 years ending in 1950 the average annual burn was 3.9 percent of the total forest area. From 1956 to 1960 it was 0.4 percent. This means that less than 49 thousand acres are now burning annually, as compared with 488 thousand acres a decade ago. The effect of improved protection is most discernible in the smaller trees sizes. Stocking of saplings, for example, has increased by more than 40 percent since 1950.

The proportion of land that is well stocked differs sharply among the major types of forest. On lands supporting southern pine, half the acreage has at least 70 percent of the number of growing stock trees needed to make full use of the site. The redcedar types, which have been heavily picked over and which are slowest to recover from cutting, are the least well stocked.

Not only is stocking increasing, but basal area in cull trees has declined nearly a fifth. One in every five trees of poletimber size and larger, however, is still a cull. Some of these trees, of course, might serve as fuelwood or other farm-use products if demand were sufficient. But the quantity is so large—nearly 1.5 billion cubic feet—that investment in deadening seems to be the only means of effectively reducing this huge volume.

The size of the cull-removal job may be estimated from table II, which shows the average number of culls per acre by tree diameter. Thus, to rid the typical stand of all culls 5.0 inches and larger in d.b.h. would mean killing 21 trees per acre, most of them under 9 inches in diameter. Ax-girdling the culls in the average stand would take almost one man-hour per acre; machine-girdling would require only half as much time. Culls 10 inches and larger in diameter will usually need only girdling; control of smaller ones will generally entail use of sprout-inhibiting chemicals.

Table II.—*Number of cull trees per acre by diameter group, 1961*

Tree diameter (inches)	Cull trees
	No.
6 — 8	14
10 — 12	4
14 — 16	2
18 +	1
Total	21

TRENDS IN TIMBER VOLUME

Big Gain In Softwood

The volume of softwood growing stock has risen sharply since 1950. It currently totals 1.2 billion cubic feet, a 33-percent increase (table III). Nearly three-fourths is southern pine. Eastern redcedar, cypress, white pine, and hemlock make up the rest (fig. 3).

Table III.—*Growing stock volume (1961) and change since 1950*

Region	Softwood		Hardwood	
	Volume	Change	Volume	Change
	Million cu. ft.	*Percent*	*Million cu. ft.*	*Percent*
West	80.4	+ 2	1,038.8	+ 14
West-central	52.5	+ 29	1,113.4	+ 38
Central	23.2	— 52	977.5	+ 2
Plateau	363.9	+ 59	1,463.4	+ 32
East	716.0	+ 34	1,380.3	+ 26
Total	1,236.0	+ 33	5,973.4	+ 22

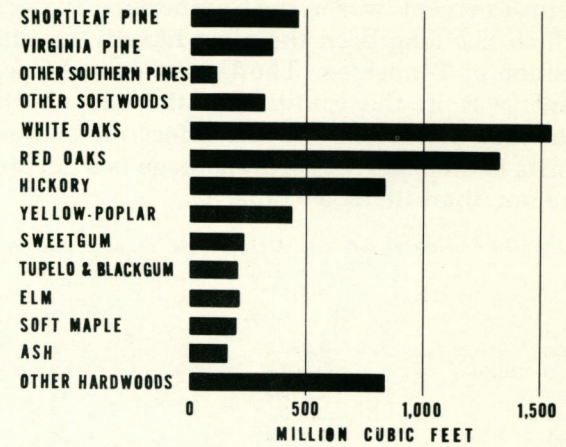


Figure 3. *Growing stock by species.*

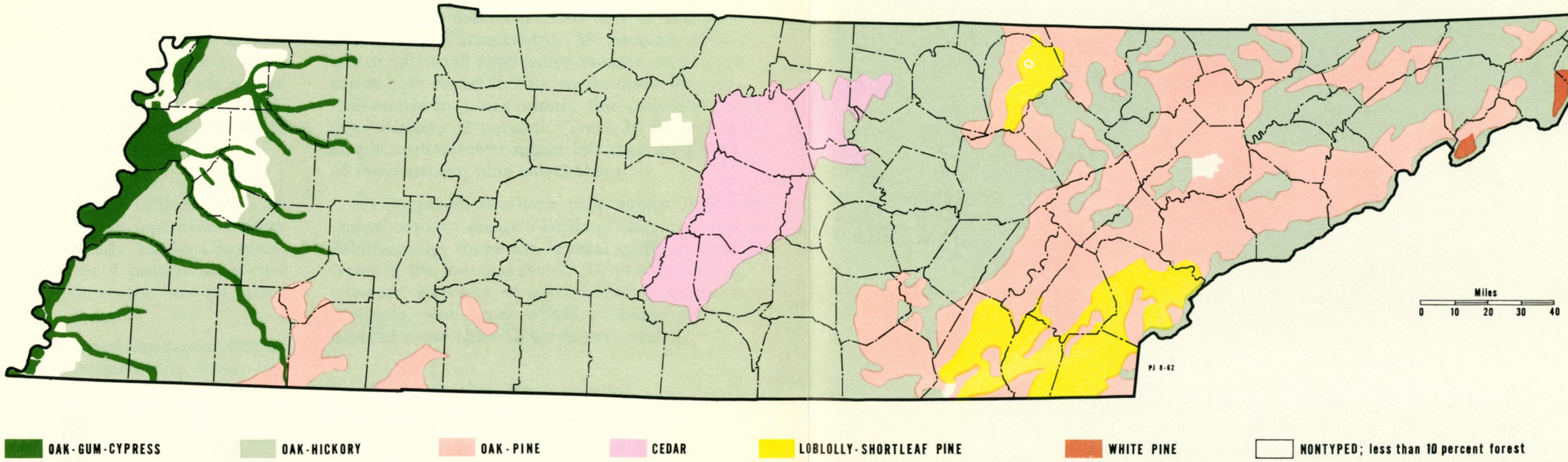


Figure 2. *Major forest types in Tennessee.*

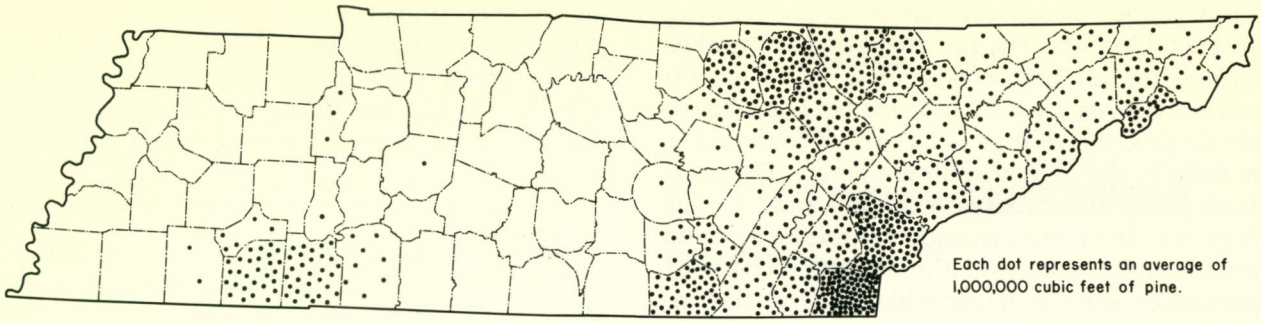


Figure 4. *Generalized distribution of southern pine growing stock in Tennessee.*

The biggest gains have taken place in the Plateau region and east Tennessee, which together have over 90 percent of the total southern pine volume (fig. 4). In the central part of the State, where softwood growing stock has been greatly reduced, virtually all of the volume is redcedar. A decline of cypress volume in west Tennessee moderated the gains of other softwood species in that region.

Statewide, board-foot volume of softwood has increased from 3.0 to 4.1 billion. Some 30 percent is concentrated on the one million acres in public ownership, mainly in the Cherokee National Forest. Another 7 percent is owned by forest industries. The rest is held by farmers and other private owners.

Much of the recent sawtimber gain is due to the ingrowth of poletimber-size trees. As shown in figure 5, for example, the increase between surveys in numbers of softwoods 10 inches in diameter exceeded that of any other size class. Furthermore, 28 percent of the entire softwood sawtimber volume in Tennessee is now found in this single diameter class. For southern pines alone, the proportion is even higher, 38 percent. Trees 16 inches and larger in diameter contain less than 20 percent of the southern pine sawtimber.

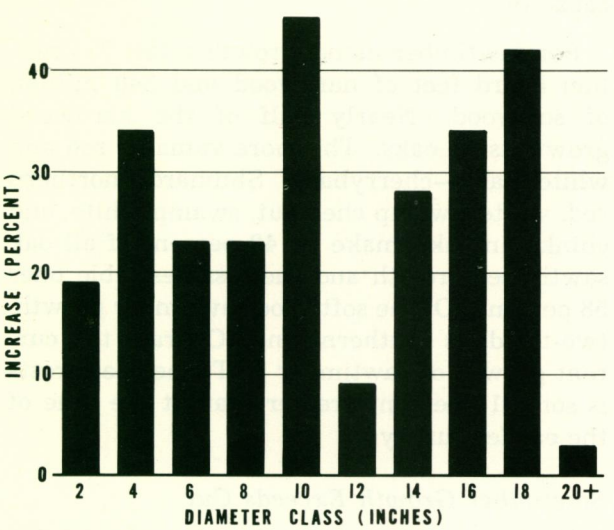


Figure 5. *Percentage change in number of softwood growing stock trees between surveys.*

All together, southern pine types in Tennessee contain about 5 cords of pine per acre. Additionally, there are several cords of hardwood in the average stand. To provide annual one-cord harvests of a combination of forest products, pine types would probably have to support more than 12 cords per acre.

Hardwood Quality Has Improved

Hardwood growing stock now stands at 6.0 billion cubic feet. This is 22 percent, or one billion cubic feet, more than in 1950.

Although some of the increase is in little-used species, the preferred hardwoods have gained also. The generally excellent form, fast growth, and desirable technical properties of yellow-poplar, for example, make it one of the most highly prized species in Tennessee. In 1961, the volume sampled of yellow-poplar totaled 435 million cubic feet, an increase of 15 percent since 1950. Hickory volume rose from 696 to 831 million cubic feet between surveys. Growth of hickory is well in excess of the cut and volume is rapidly accumulating. Effective utilization of this widely distributed hardwood could greatly enhance timber management opportunities.

Sawtimber trends parallel those for growing stock (table IV). The net change in sawtimber volume for all hardwoods amounts to an 18-percent rise, or 2.4 billion board feet. As figure 6 indicates, the change is largely accounted for by trees under 16 inches in diameter. The relatively modest increase in 18-inch and larger trees is noteworthy, though. These large trees are the main source of the annual harvest of sawtimber—the indispensable part of the inventory from the viewpoint of traditional hardwood industries.

Table IV.—*Sawtimber volume (1961) and change since 1950*

Region	Softwood		Hardwood	
	Volume	Change	Volume	Change
	Million bd. ft.	*Percent*	*Million bd. ft.*	*Percent*
West	326.0	− 1	3,052.9	+ 5
West-central	133.6	+ 36	2,248.3	+ 31
Central	27.9	− 56	2,594.9	− 3
Plateau	1,067.6	+ 53	4,072.0	+ 32
East	2,573.7	+ 40	3,984.9	+ 26
Total	4,128.8	+ 37	15,953.0	+ 18

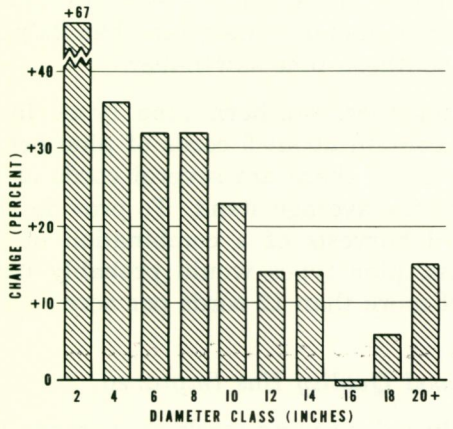


Figure 6. *Percentage change in number of hardwood growing stock trees between surveys.*

Another promising aspect of the hardwood situation is sawlog quality, as expressed by grades that take into account the diameter, length, and amount of defects in individual logs. Of the net board-foot increase, 1.1 billion is in logs of standard factory lumber grades 1 and 2 (table V). Such logs are most generally in demand because they yield much high-quality material. Moreover, some two-fifths of the increase of 1.3 billion board feet in lower grade logs is suitable for conversion into standard lumber, in the sense that it will yield practical proportions of clear cuttings. The rest consists of tie and timber logs—those with so many sound defects that they will not produce worthwhile amounts of clear boards, when sawn wholly into lumber. They are presently suited for low-value uses such as crating and crossties.

Table V.—*Sawtimber volume by log grade and tree diameter, 1961*

Species group and d.b.h. class (inches)	All grades	Grade 1 [1]	Grade 2	Lower grades
	Million board feet			
Softwood:				
10 to 12	2,064.1	83.1	35.0	1,946.0
14 to 18	1,640.7	25.7	241.9	1,373.1
20 and up	424.0	34.3	39.6	350.1
Total	4,128.8	143.1	316.5	3,669.2
Hardwood:				
12	3,781.2	...	53.3	3,727.9
14 to 18	8,195.7	500.7	2,258.5	5,436.5
20 and up	3,976.1	1,044.6	1,087.7	1,843.8
Total	15,953.0	1,545.3	3,399.5	11,008.2

[1] All cedar sawlogs were graded as No. 1.

TIMBER GROWTH AND CUT

Annual Growth Is Increasing

Yearly timber mortality ascribed to forest fires, insect pests, tree diseases, and other natural causes exceeds 53 million cubic feet. The loss is equivalent to 17 percent of the net growth of growing stock, and is much higher in hardwoods than in softwoods. After allowance is made for mortality, net annual growth is 256 million cubic feet of hardwood growing stock and 66 million of softwood. This equals 24 cubic feet per acre a year, or about 0.35 cord. At this rate, the forests are growing wood at only one-third of their productive capacity.

For sawtimber alone, growth totals 733 million board feet of hardwood and 248 million of softwood. Nearly half of the hardwood growth is on oaks. The more valuable red and white oaks—cherrybark, Shumard, northern red, white, swamp chestnut, swamp white, and chinkapin oak—make up 42 percent of all oak sawtimber growth and the less desirable ones 58 percent. Of the softwood sawtimber growth, two-thirds is southern pine. Overall, the current growth of sawtimber in Tennessee forests is some 10 percent greater than at the time of the earlier survey.

Sawtimber Growth Exceeds Cut

Timber cutting removed 162 million cubic feet of hardwood growing stock and 45 million

cubic feet of softwood from commercial forest land in 1960. Four-fifths of all the softwood was southern pine. Of the hardwoods, oak made up 62 percent. Other hard hardwoods accounted for 21 percent, soft hardwoods, like yellow-poplar, comprised the remaining 17 percent.

Tennessee's primary wood-using industries are largely dependent upon material harvested from sawtimber trees—softwoods at least 9 inches in diameter, and hardwoods 11 inches and larger in d.b.h. For the State as a whole, sawtimber growth exceeded the 1960 cut by 26 percent (fig. 7). The ratios of growth to cut have improved markedly since 1950. Whereas the growth of softwood sawtimber was less than two-thirds of the cut in 1949, it is estimated to be nearly 50 percent greater than the 1960 cut. For hardwoods, sawtimber growth was slightly less than the 1949 cut, but in 1960 it exceeded the cut by some 20 percent. Both in softwoods and hardwoods this favorable

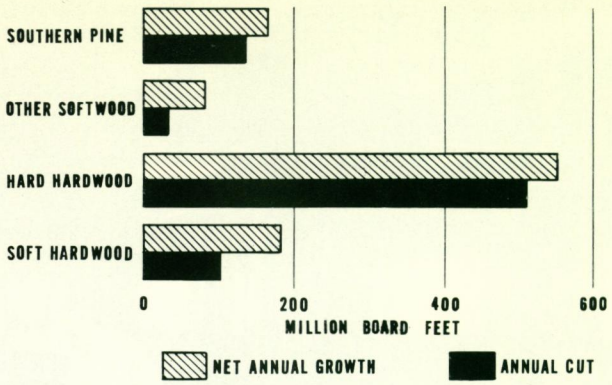


Figure 7. *Growth and cut of sawtimber, 1960.*

balance has been achieved by reduced cutting, as well as increased growth. The encouraging trends in growth-cut ratios must be tempered by realization that much of the excess growth is needed to further build up stocking, if Tennessee's forest lands are to more nearly approach their full productive capacity.

NO SMOKING

Timber Products Output

Production of industrial roundwood in Tennessee totaled 145 million cubic feet in 1960. Output of domestic-use products, chiefly fuelwood, was 39 million.

The composition of Tennessee's timber output changed sharply during the past decade. In 1949 half of the annual output was for domestic use. Today about 20 percent is for these purposes. Although domestic timber use declined drastically, the harvest of industrial roundwood is 16 percent greater than in 1949. Sawlogs and pulpwood now make up 88 percent of the industrial output. The rest is largely veneer logs, cooperage bolts, poles, piling, posts, and mine timbers.

MORE LARGE SAWMILLS

Tennessee is a leading hardwood manufacturer. The most recent census ranked it second among all States in the production of hardwood lumber.

In 1960 the production of logs for lumber totaled nearly 634 million board feet, of which three-fourths was hardwood. Red and white oaks supplied nearly half of the hardwood; yellow-poplar, sweetgum, blackgum, and tupelo made up most of the remainder. Southern pine accounted for the great bulk of the softwood, but some cypress, redcedar, white pine, and hemlock was also sawn.

As in neighboring States, the sawmill industry has undergone striking changes since the close of World War II. In 1946, when the last complete mill canvass was made, 2,789 sawmills were reported active. Mills cutting more than 3 million board feet annually numbered 19 at that time and produced about a tenth of the lumber manufactured in the State. In 1960, 1,135 sawmills were operating. The losses were entirely among small, generally portable mills; large mills increased in number from 19 to 20. The heaviest concentration of large mills is at Memphis. Output from the large mills is mainly hardwood; most of the pine is still sawn by small mills.

While the number of mills has dropped sharply, average annual output per mill nearly doubled between 1946 and 1960. Moreover, it is estimated that mills sawing more than 3 million board feet annually now process about a fifth of the State's lumber output. In contrast to the small mills, which obtain practically all of their logs from nearby woodlots, the large mills reach across the State boundaries for at least a fourth of their log requirements.

PULPWOOD AT RECORD HIGH

The tremendous growth in pulpwood cutting is undoubtedly the most noteworthy forestry development in Tennessee within the past several years. It is enabling more and more landowners to improve their stands by marketing trees that are not needed for more exacting products.

Pulpwood bolt output surged from 144 thousand cords in 1950 to 353 thousand in 1960. In 1961, it hit an all-time high of 404 thousand cords (fig. 8). Although sawlogs still account for the lion's share of the industrial roundwood output, the pulpwood segment jumped from 10 to 19 percent between 1949 and 1960.

Pulpwood is now mostly southern pine. Prior to 1954, it was chiefly hardwood. The shift reflects large-scale local expansion of pulping processes for which the use of pine is favored. The use of hardwood is also increasing, however, and output is nearly double that of 1950.

Establishment of two new pulp mills, as well as expansion of existing facilities, boosted

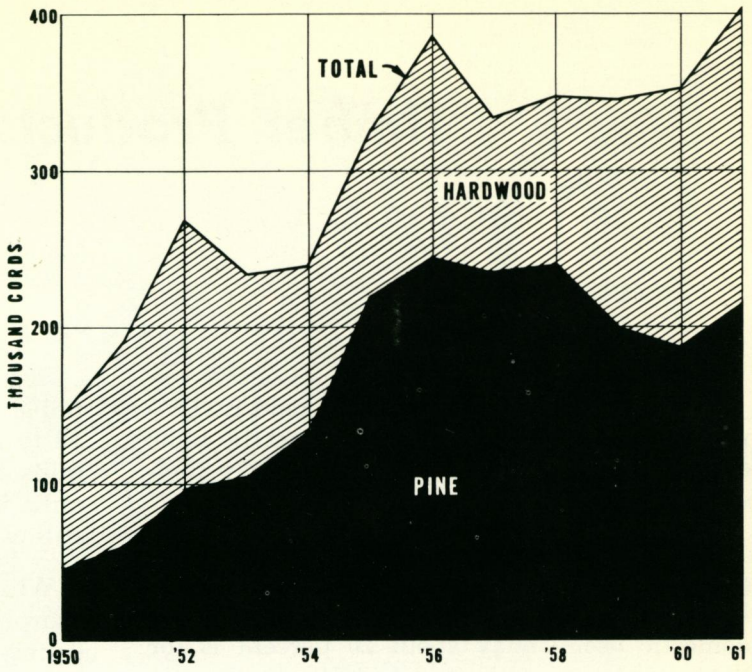


Figure 8.
Production of pulpwood bolts, 1950-61.

Tennessee's daily pulping capability from 358 tons in 1950 to 2,357 tons in 1960. Tennessee's five pulp mills presently account for 11 percent of the total mill capacity in the seven Midsouth States. Manufacturing capacity of the average mill is about 471 tons per day, as compared to 90 tons a decade earlier. Individual mill capability ranges from 112 tons to 1,375 tons daily.

Further gains can be expected during the decade ahead. Net 1960 imports of pulpwood cordage totaled 262 thousand, a volume equivalent to three-fourths of Tennessee's pulpwood harvest in that year. As the inventory of standing timber (especially pine) rises further, it should be feasible for the industry to draw a substantially larger share of its wood requirements from local sources.

VENEER IS MAINLY HARDWOOD

About a third of the veneer logs processed in Tennessee are converted into containers of various kinds. The rest are largely cut into commercial veneers—chiefly for cores, crossbands, and backs of plywood.

Less than half of the logs received by veneer plants are cut within the State. The harvest of veneer logs in 1960 totaled 11.1 million board feet, of which 2.2 million were shipped to other States. Some 11.4 million board feet were imported. Domestic imports were drawn from 11 States, the most distant of which were New York and Pennsylvania. Foreign imports included lauan (Philippine mahogany) and khaya (African mahogany) logs. The 9 veneer mills in the State thus consumed an average of more than 2.2 million board feet per plant (fig. 9). The 14 plants active in 1949 used an average of 1.5 million per plant.

Practically all of the volume consumed by the veneer industry was obtained through open-market dealings. More than 90 percent was bought as logs from sawmills, contract loggers, and other sources. The rest was largely acquired by stumpage purchases; volume cut on company-owned forests was negligible.

All but 3 percent of the veneer logs made in Tennessee are hardwood. Most of the softwood is redcedar. Hardwood logs are about equally divided between soft- and hard-hardwood species. Gums and yellow-poplar, which made up nearly 60 percent of the veneer log production in 1949, supplied only a third of the 1960 total. The decline apparently reflects the limited availability of suitable timber in these preferred veneer species.

OTHER PRODUCTS

Cooperage is a leading specialty item in Tennessee. In 1960, 33 mills were cutting tight cooperage; 4 slack cooperage mills were engaged in making tobacco hogsheads. Production of cooperage roundwood totaled 25.6 million board feet, of which 3.3 million was shipped to nearby States for processing. Another 4.9 million board feet was brought into Tennessee for manufacture. Of the roundwood used by the cooperage industry in 1960, 24 million board feet was for tight cooperage, made exclusively from white oak. Oak and hickory furnished the great bulk of the slack cooperage, but other species, including southern pine, were used.

Production of roundwood fuel in Tennessee plunged from 1.7 million cords in 1949 to 0.4 million in 1960, a 75-percent decline. Use of mill residues (mainly sawmill slabs) for fuel also dropped some 29 percent; 1960 output from these sources totaled 271 thousand cords. The decline is largely due to the substitution of more convenient fuels for heating and cooking in rural areas. Rising urbanization and per capita income are expected to further reduce domestic fuelwood consumption. Moreover, it appears that an increasing proportion of the volume consumed will be derived from mill residues rather than roundwood.

All other timber products harvested in 1960 supplied 11 percent of the total roundwood output in Tennessee. Their volume, 20.3 million cubic feet, was mostly in fence posts and chemical wood.

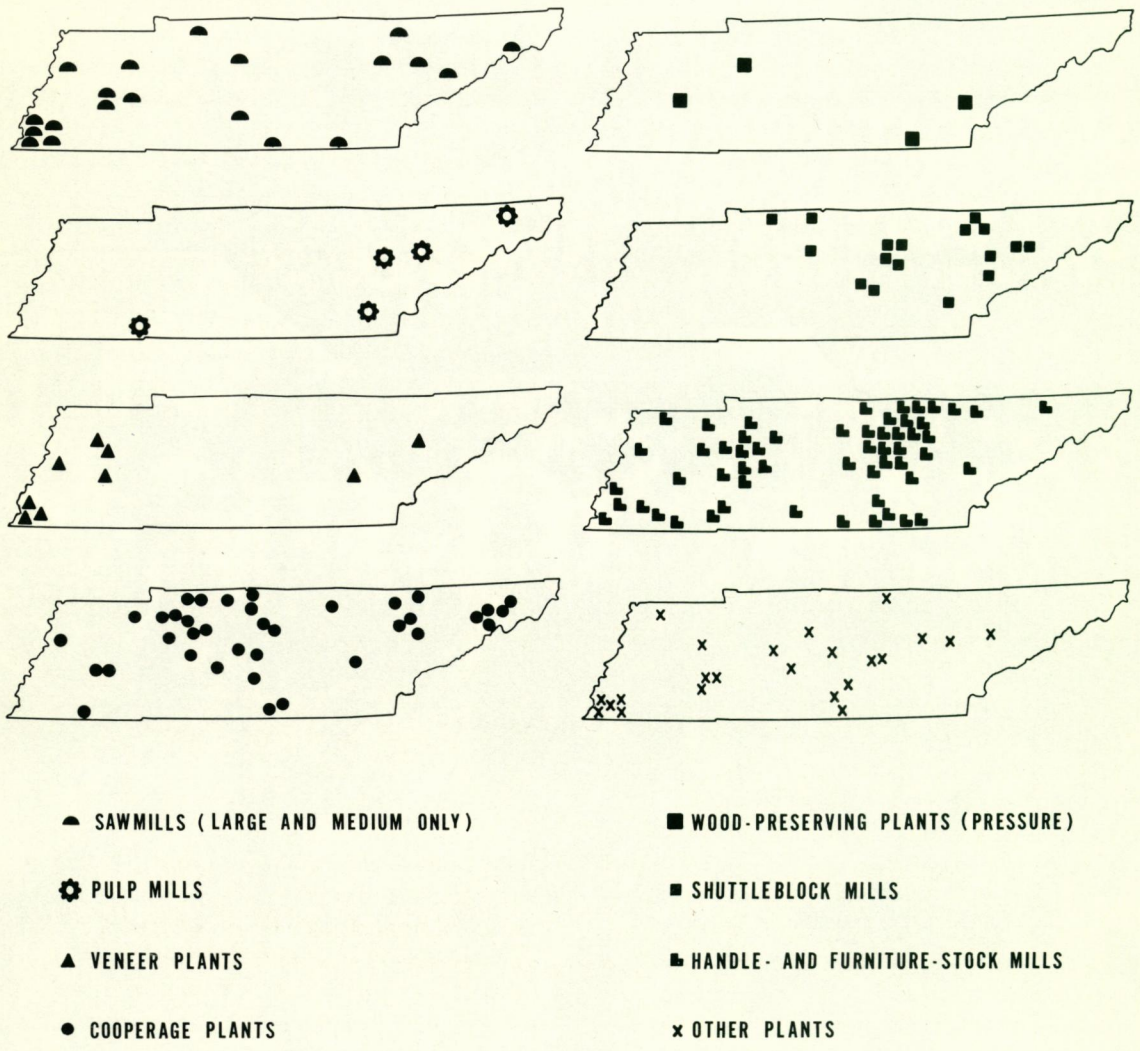
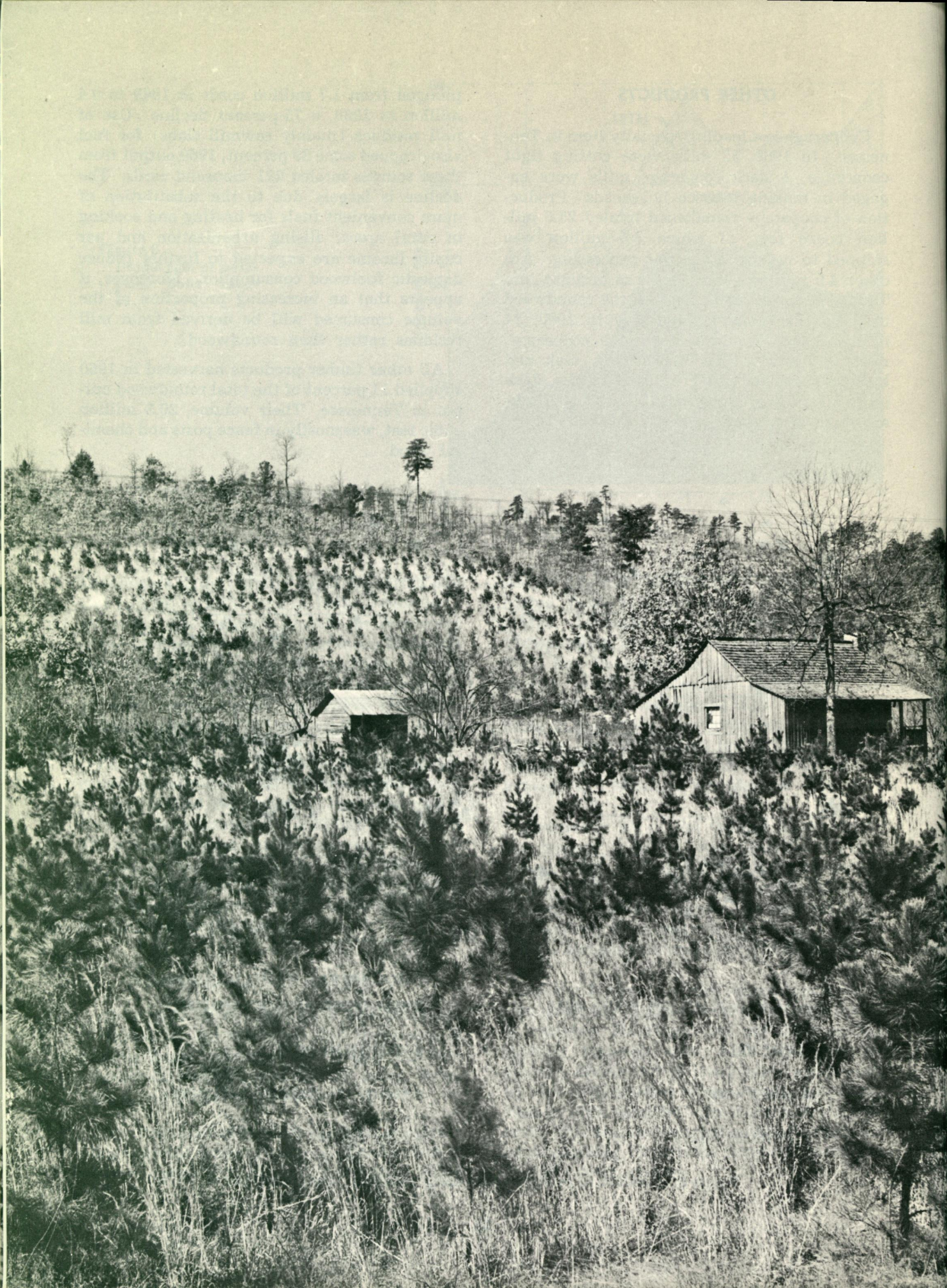


Figure 9. *Location of primary wood-using plants in Tennessee, 1960.*



Outlook For Timber Supplies

The timber outlook in Tennessee brightened noticeably during the past decade. Not only are volumes of both pine and hardwood greater now than in 1950, but under the assumptions made for one possible projection, the timber inventory could rise to 12.4 billion cubic feet by 1991. The assumptions are that timber output in the United States and Tennessee will increase with anticipated gains in population and gross national product; that industrial wood products will largely maintain their relative position in the national economy; and that forestry progress will continue at the rate indicated by recent trends.

Even so, the future timber cut is assumed to be not much more than 20 percent greater than the present annual harvest of 208 million cubic feet. This is partly because the expected decline in fuelwood cutting will offset some of the gain anticipated in the use of industrial wood. Yet, as noted earlier, Tennessee's forests can grow far more wood than is indicated by the assumed cut. It is apparent that if their potential is to be fully realized within the next few decades, forestry efforts must be strengthened—especially on the farm woodlands and other small holdings that make up 4 out of every 5 acres of privately owned timberland in the State.

BUILDING UP PINE STOCKING

Of the 13.4 million acres of commercial forest land in Tennessee, 5 million are suitable for growing pine—as evidenced by pine's present or former occurrence.

Four million acres of the potential pine sites are less than 40 percent stocked with desirable timber—that is, thrifty trees that are presently or potentially capable of yielding high-quality sawlogs and other forest products. Very little of the latter acreage—scarcely 53 thousand acres—is expected to restock itself adequately without cultural measures within the next 10 years. On 0.5 million acres, planting alone is likely to improve future harvest yields. Most of this acreage is east of the Highland Rim. Another 0.7 million acres requires removal of culls or other undesirable trees in order to assure successful establishment of natural pine reproduction. But on the majority of pine sites —2.7 million acres—restoration may be more expensive. Here, both planting and removal of undesirable trees will be needed if timber yields are to be effectively increased.

Not included in the above estimates are several hundred thousand acres of fields that have been out of cultivation for a number of years but have not yet reverted to forest. Some of these areas are of course highly plantable for timber production.

About 0.9 million acres of pine sites are already 40 to 70 percent stocked with desirable trees. Thus the opportunity to improve the productivity of this area is especially favorable. Some 0.5 million acres of the total is encumbered with trees whose defects limit their present or prospective use. Removal of this material will not only create openings for reproduction, but also encourage the more rapid development of desirable trees already established.

The remaining 0.1 million acres of pine sites are more than 70 percent stocked with desirables. Given adequate protection from fire and premature cutting, these stands can be expected to produce excellent crops of pine.

IMPROVING HARDWOOD STANDS

Tennessee has 8.4 million acres of commercial forest that appear to be primarily suited to growing hardwood. The management possibilities of these forests have only recently been recognized. Although hardwood volume is now increasing, most stands are still deficient in timber of the quality, size, and utility demanded by the distinctive hardwood industries. Furthermore, the typical hardwood stand contains a high proportion of trees that are undesirable as future growing stock. All told, the productivity of some 7.5 million acres of hardwood sites is noticeably hampered by culls and other trees that are of little potential value.

After merchantable components of this overburden have been removed, the greatest returns per dollar of expenditure will probably be realized by concentrating improvement efforts on large dominant culls. Restricting cull-tree control to the larger trees will not improve areas covered with thickets of small weed trees or shrubs. These areas need some kind of blanket treatment, but further study is required to develop economical methods of handling such situations.

Although there are many aspects of hardwood culture on which additional research is urgently needed, sufficient experience and technical data have been accumulated to put many of the essentials of management into practice. The future of industries dependent upon hardwoods in Tennessee largely hinges on the efforts that landowners direct towards increasing yields of desirable trees.

Appendix

ACCURACY OF THE SURVEY

The data on forest acreage and timber volume in this report were secured by a systematic sampling method involving a forest-nonforest classification on aerial photographs and on-the-ground measurements of trees at sample locations. The sample locations were at the intersections of a grid of lines spaced 4.2 miles apart. At each location, 10 small plots were systematically distributed on an area of about one acre.

Accuracy of the estimates may be affected by two types of errors. The first stems from the use of a sample to estimate the whole and from variability of the items being sampled. This type is termed sampling error; it is susceptible to a mathematical evaluation of the probability of error. The second type—often referred to as reporting or estimating error—derives from mistakes in measurement, judgment, arithmetic, or recording, and limitations of method or equipment. Its effects cannot be appraised mathematically, but the Forest Survey constantly attempts to hold such error to a minimum by proper training and good supervision, and by emphasis on careful work.

Statistical analysis of the data indicates a sampling error of plus or minus 0.3 percent for the estimate of total forest area, 2.4 percent for total cubic volume, and 3.5 percent for total board-foot volume. As these totals are broken down by forest type, species, tree diameter, and other subdivisions, the possibility of error increases and is greatest for the smallest items. The order of this increase is suggested in the following tabulation, which shows the sampling error to which the estimates are liable, two chances out of three.

Forest area	Sampling error [1]	Cubic volume	Sampling error [2]	Board-foot volume	Sampling error [2]
Thousand acres	*Percent*	*Million cu. ft.*	*Percent*	*Million bd. ft.*	*Percent*
13,695.9	0.3	...	...	...	...
1,232.6	1.0	...	...	...	...
308.2	2.0	7,209.4	2.4	...	...
137.0	3.0	4,614.0	3.0	20,081.8	3.5
77.0	4.0	2,595.4	4.0	15,375.1	4.0
49.3	5.0	1,661.0	5.0	9,840.1	5.0
12.3	10.0	415.3	10.0	2,460.0	10.0
5.5	15.0	184.6	15.0	1,093.3	15.0
3.1	20.0	103.8	20.0	615.0	20.0
2.0	25.0	66.4	25.0	393.6	25.0

[1] By random-sampling formula.

[2] Estimated by use of a procedure described by D. B. DeLury in **Values and Integrals of the Orthogonal Polynominals up to n = 26.** Univ. Toronto Press, 33 pp. Toronto, Ont. 1950.

Growth estimates were derived from radial-growth measurements and mortality data taken at sample locations. No attempt was made to calculate sampling error in these estimates.

Estimates of annual timber cut are based on studies conducted during the period of forest inventory. The sampling error to which the estimates are liable, on a probability of two chances out of three, are:

Cubic volume	Sampling error [1]	Board-foot volume	Sampling error [1]
Million cu. ft.	*Percent*	*Million bd. ft.*	*Percent*
207.7	5.5	779.4	6.0
62.8	10.0	280.6	10.0
27.9	15.0	124.7	15.0
15.7	20.0	70.1	20.0
10.1	25.0	44.9	25.0

[1] By random-sampling formula.

In computing changes in timber volumes since 1950, data from the earlier survey were adjusted to make them closely comparable to those from the latest survey. This was necessary because of certain basic differences between the two sets of data. In every case, the data from the earlier survey were adjusted to conform to the standards of the latest survey before the change was computed.

DEFINITIONS OF TERMS

Forest Land Class

Forest land.—Land at least 10 percent stocked by forest trees of any size, or formerly having such tree cover, and not currently developed for nonforest use.

Commercial forest land.—Forest land which is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization.

Productive-reserved forest land.—Productive public forest land withdrawn from timber utilization through statute or administrative regulation.

Unproductive forest land.—Forest land incapable of yielding crops of industrial wood because of adverse site conditions.

Tree Species

Commercial species.—Tree species presently or prospectively suitable for industrial wood products;

excludes so-called weed species, such as blackjack oak and blue beech.

Hardwoods.—Dicotyledonous trees, usually broad-leaved and deciduous.

Softwoods.—Coniferous trees, usually evergreen, having needle or scale-like leaves.

Forest Type

White-red-jack pine.—Forests in which 50 percent or more of the stand is eastern white pine, red pine, or jack pine, singly or in combination. Common associates include hemlock, aspen, birch, and maple.

Spruce-fir.—Forests in which 50 percent or more of the stand is spruce or true firs, singly or in combination. Common associates include white cedar, tamarack, maple, birch, and hemlock.

Loblolly-shortleaf pine.—Forests in which 50 percent or more of the stand is loblolly pine, shortleaf pine, or other southern yellow pines except longleaf or slash pine, singly or in combination. Common associates include oak, hickory, and gum.

Oak-pine.—Forests in which 50 percent or more of the stand is hardwoods, usually upland oaks, but in which southern pines make up 25-49 percent of the stand. Common associates include gum, hickory, and yellow-poplar.

Cedar.—Forests in which 25 percent or more of the stand is redcedar. Common associates include oak and hickory.

Oak-hickory.—Forests in which 50 percent or more of the stand is upland oaks or hickory, singly or in combination, except where pines comprise 25-49 percent, in which case the stand would be classified oak-pine. Common associates include yellow-poplar, elm, maple, and black walnut.

Oak-gum-cypress.—Bottomland forests in which 50 percent or more of the stand is tupelo, blackgum, sweetgum, oaks, or southern cypress, singly or in combination, except where pines comprise 25-49 percent, in which case the stand would be classified oak-pine. Common associates include cottonwood, willow, ash, elm, hackberry, and maple.

Elm-ash-cottonwood.—Forests in which 50 percent or more of the stand is elm, ash, or cottonwood, singly or in combination. Common associates include willow, sycamore, beech, and maple.

Maple-beech-birch.—Forests in which 50 percent or more of the stand is maple, beech, or yellow birch, singly or in combination. Common associates include hemlock, elm, basswood, and white pine.

Class of Timber

Growing-stock trees.—Sawtimber trees, poletimber trees, saplings, and seedlings; that is, all live trees except cull trees.

Desirable trees.—Growing-stock trees that have no serious defects to limit present or prospective use, are of relatively high vigor, and contain no pathogens that may result in death or serious deterioration before rotation age. They comprise the type of trees that forest managers aim to grow, that is, the trees left in silvicultural cutting or favored in cultural operations.

Acceptable trees.—Trees meeting the specifications for growing stock but not qualifying as desirable trees.

Sawtimber trees.—Live trees of commercial species, 9.0 inches and larger in diameter at breast height for softwoods and 11.0 inches and larger for hardwoods, and containing at least one sawlog.

Poletimber trees.—Live trees of commercial species, 5.0 to 9.0 inches in d.b.h. for softwoods and 5.0 to 11.0 inches for hardwoods, and of good form and vigor.

Saplings.—Live trees of commercial species, 1.0 inch to 5.0 inches in d.b.h. and of good form and vigor.

Cull trees.—Live trees of sawtimber or poletimebr size that are unmerchantable for sawlogs now or prospectively because of defect, rot, or species.

Salvable dead trees.—Standing or down dead trees that are considered currently or potentially merchantable.

Stand-Size Class

Sawtimber stands.—Stands at least 10 percent stocked with growing-stock trees, and with sawtimber trees making up a plurality of this stocking.

Poletimber stands.—Stands at least 10 percent stocked with growing-stock trees, and with pole--timber trees making up a plurality of this stocking.

Sapling-seedling stands.—Stands at least 10 percent stocked with growing-stock trees, and with saplings and/or seedlings making up a plurality of this stocking.

Nonstocked areas.—Commercial forest lands less than 10 percent stocked with growing-stock trees.

Stocking

A measure of area occupancy by trees of specified classes. Three categories of stocking are considered in the Survey: (1) all live trees, (2) growing-stock trees, and (3) desirable trees. Stocking in terms of all trees is used in the delineation of forest land and forest types. Stocking in terms of growing-stock trees is used in stand-size and age classifications. Stocking in terms of desirable trees is used in delineating area-condition and stand-treatment classes.

Volume

Volume of sawtimber.—Net volume of the sawlog portion of live sawtimber trees, in board feet of the International rule, ¼-inch kerf.

Volume of growing stock.—Volume of sound wood in the bole of sawtimber and poletimber trees from stump to a minimum 4.0-inch top outside bark or to the point where the central stem breaks into limbs.

Volume of timber.—The volume of sound wood in the bole of growing stock, cull, and salvable dead trees 5.0 inches and larger in d.b.h., from stump to a minimum 4.0-inch top outside bark or to the point where the central stem breaks into limbs.

Softwood Log Grades

Softwood log grades are based on the value yield per unit outturn of yard lumber. The value of lumber yield may be expressed relative to the value of No. 2 Common lumber taken as 100 percent. Expressed thus, studies have shown that lumber from grade 1 logs has a value 244 percent as great as No. 2 Common lumber, while the corresponding percentages are 189 percent for grade 2 logs, 142 percent for grade 3 logs, and 107 percent for grade 4 logs. For detailed specifications of log grades, see **Interim log grades for southern pine,** U. S. Forest Service, Southern Forest Experiment Station, 18 pp. 1953.

Hardwood Log Grades

Specifications for standard lumber logs (hardwood log grades 1, 2, and 3) are based on suitability for standard factory lumber. Studies have shown that, for nearly all species tested, the yield of No. 1 Common and better lumber in grade 1 logs varies from 65 to 80 percent; in grade 2 logs from 40 to 64 percent; and in grade 3 logs from 13 to 36 percent. For detailed specifications of log grades, see **Hardwood log grades for standard lumber: proposals and results,** U. S. Forest Products Laboratory D1737. 1949.

Tie and timber logs are suitable for ties, timber, and certain other construction lumber items. Specifications for tie and timber logs are based chiefly on knot size and log soundness; clear cuttings are not required.

Area-Condition Class

Class 1.—Areas 70 percent or more stocked with desirable trees.

Class 2.—Areas 40 to 70 percent stocked with desirable trees and with 30 percent or less of the area controlled by other trees and/or inhibiting vegetation or surface conditions that will prevent occupancy by desirable trees.

Class 3.—Areas 40 to 70 percent stocked with desirable trees and with more than 30 percent of the area controlled by other trees and/or inhibiting vegetation or surface conditions that will prevent occupancy by desirable trees.

Class 4.—Areas less than 40 percent stocked with desirable trees and with adequate seed source and seedbed favorable to natural restocking.

Class 5.—Areas less than 40 percent stocked with desirable trees and with inadequate seed source and/or seedbed unfavorable to natural regeneration.

Stand-Treatment Class

No treatment.—Stands ready for harvest, stands in highly productive condition, stands where there is little or no practical opportunity to increase harvest yields by cultural measures, and areas where prompt natural regeneration is expected.

Stand improvement.—Stands where cleaning, thinning, cull-tree deadening, sanitation-salvage cutting, or pruning will effectively increase the volume and/or value of harvest yields.

Regeneration.—Areas where planting, seeding, scarification, removal of inhibiting vegetation, or other measures to obtain natural or artificial regeneration will be primarily effective in increasing yields of desirable trees.

Miscellaneous Definitions

D.b.h. (Diameter breast high).—Tree diameter in inches, outside bark, measured at 4-½ feet above ground.

Diameter classes.—The 2-inch diameter classes extend from 1.0 inch below to 0.9 inch above the stated midpoint. Thus, the 12-inch class includes trees 11.0 inches to and including 12.9 inches d.b.h.

Site classes.—A classification of forest land in terms of inherent capacity to grow crops of industrial wood.

Farmer-owned lands.—Lands owned by operators of farms.

Net annual growth of sawtimber.—The annual change in net board-foot volume of live sawtimber trees during a specified period resulting from natural causes.

Net annual growth of growing stock.—The annual change in volume of sound wood in live sawtimber and poletimber trees during a specified period resulting from natural causes.

Mortality of sawtimber.—The net board-foot volume of sawtimber trees dying annually from natural causes during a specified period.

Mortality of growing stock.—The volume of sound wood in live sawtimber and poletimber trees dying annually from natural causes during a specified period.

Timber cut from sawtimber.—The net board-foot volume of live sawtimber trees cut for forest products during a specified period, including both roundwood products and logging residues.

Timber cut from growing stock.—The volume of sound wood in live sawtimber and poletimber trees cut for forest products during a specified period, including both roundwood products and logging residues.

Timber products.—Roundwood products and by-products of wood manufacturing plants.

STANDARD TABLES

Tables identical in format to those that follow will be found in all State reports issued by the Forest Survey. Their purpose is to facilitate compilation of data for various States and regions.

Table 1. *Area by land classes, Tennessee, 1961*

Land class	Area
	Thousand acres
Forest:	
Commercial	13,432.4
Productive-reserved	263.5
Total forest	13,695.9
Nonforest [1]	12,826.2
All land [2]	26,522.1

[1] Includes some acreage of water according to survey standards of area classification but defined by Bureau of the Census as land.
[2] From U. S. Bureau of the Census, Land and Water Area of the United States, 1950.

Table 2. *Area of commercial forest land by ownership classes, Tennessee, 1961*

Ownership class	Area
	Thousand acres
Public:	
National forest	591.3
Miscellaneous federal	242.9
State	343.5
County and municipal	21.4
Total public	1,199.1
Private:	
Forest industry	945.9
Farmer	5,911.8
Miscellaneous private	5,375.6
Total private	12,233.3
All ownerships	13,432.4

Table 3. *Area of commercial forest land by stand-size and ownership classes, Tennessee, 1961*

Stand-size class	All ownerships	National forest	Other public	Forest industry	Farmer and misc. private
	Thousand acres				
Sawtimber	5,634.8	443.4	313.5	430.0	4,447.9
Poletimber	4,041.6	103.2	177.5	324.1	3,436.8
Sapling and seedling	3,591.3	44.7	116.8	191.8	3,238.0
Nonstocked areas	164.7	...	...	...	164.7
All classes	13,432.4	591.3	607.8	945.9	11,287.4

Table 4. *Area of commercial forest land by stand-volume classes for sawtimber and other stand-size classes, Tennessee, 1961*

Stand volumes per acre	All stands	Sawtimber stands	Other stands
	Thousand acres		
Less than 1,500 board feet	9,030.7	1,452.7	7,578.0
1,500 to 5,000 board feet	3,580.5	3,360.9	219.6
More than 5,000 board feet	821.2	821.2	...
All classes	13,432.4	5,634.8	7,797.6

Table 5. *Area of commercial forest land by stocking classes based on alternative stand components, Tennessee, 1961*

Stocking percentage	Stocking classified in terms of		
	All trees	Growing stock trees	Desirable trees
	Thousand acres		
90 to100	2,488.9	561.2	29.5
80 to 90	4,458.1	2,067.4	59.9
70 to 80	2,275.3	1,670.6	69.2
60 to 70	2,531.3	3,871.6	265.5
50 to 60	574.5	1,549.3	250.1
40 to 50	611.4	2,156.9	1,197.6
30 to 40	164.7	553.5	1,228.9
20 to 30	221.0	665.1	3,608.1
10 to 20	47.6	172.1	2,450.1
Less than 10	59.6	164.7	4,273.5
All areas	13,432.4	13,432.4	13,432.4

Table 6. *Area of commercial forest land by stocking classes of growing stock trees and by stand-size classes, Tennessee, 1961*

Stocking class	All stands	Saw-timber	Pole-timber	Sapling and seedling	Non-stocked
	Thousand acres				
70 percent or more	4,299.2	2,369.3	1,258.7	671.2	...
40 to 70 percent	7,577.8	2,936.1	2,516.3	2,125.4	...
10 to 40 percent	1,390.7	329.4	266.6	794.7	...
Less than 10 percent	164.7	...	...	...	164.7
All classes	13,432.4	5,634.8	4,041.6	3,591.3	164.7

Table 7. *Area of commercial forest land by area-condition and ownership classes, Tennessee, 1961*

Area-condition class	All ownerships	National forest	Other public	Forest industry	Farmer and misc. private
	Thousand acres				
1	158.6	10.9	34.3	...	113.4
2	548.8	21.9	9.8	29.5	487.6
3	1,164.4	71.8	66.9	67.0	958.7
4	717.7	31.9	23.0	19.9	642.9
5	10,842.9	454.8	473.8	829.5	9,084.8
All classes	13,432.4	591.3	607.8	945.9	11,287.4

Table 8. *Area of commercial forest land by area-condition and stand-treatment classes, Tennessee, 1961*

Area-condition class	All areas	No treatment	Stand improvement	Regeneration
	Thousand acres			
1	158.6	158.6	...	...
2	548.8	548.8	...	...
3	1,164.4	...	1,164.4	...
4	717.7	717.7	...	...
5	10,842.9	...	...	10,842.9
All classes	13,432.4	1,425.1	1,164.4	10,842.9

Table 9. *Area of commercial forest land by site and ownership classes, Tennessee, 1961*

Site class	All ownerships	National forest	Other public	Forest industry	Farmer and misc. private
Potential per acre annual growth	*Thousand acres*				
120 cu. ft. or more	774.6	103.7	63.6	55.1	552.2
85 to 120 cu. ft.	3,812.3	151.0	216.5	409.6	3,035.2
50 to 85 cu. ft.	6,754.7	247.9	293.8	425.2	5,787.8
Less than 50 cu. ft.	2,090.8	88.7	33.9	56.0	1,912.2
All classes	13,432.4	591.3	607.8	945.9	11,287.4

Table 10. *Area of commercial forest land by forest types and ownership classes, Tennessee, 1961*

Type	All ownerships	Public	Private
	Thousand acres		
White-red-jack pine	84.6	17.9	66.7
Loblolly-shortleaf pine	1,113.0	151.9	961.1
Oak-pine	922.7	153.7	769.0
Cedar	637.0	32.7	604.3
Oak-hickory	9,591.0	743.2	8,847.8
Oak-gum-cypress	663.9	52.7	611.2
Elm-ash-cottonwood	220.8	13.1	207.7
Maple-beech-birch	199.4	33.9	165.5
All types	13,432.4	1,199.1	12,233.3

Table 11. *Area of noncommercial forest land by forest types, Tennessee, 1961*

Type	Area [1]
	Thousand acres
White-red-jack pine	55.8
Spruce-fir	15.6
Loblolly-shortleaf pine	12.3
Oak-pine	43.2
Oak-hickory	102.1
Oak-gum-cypress	1.2
Maple-beech-birch	33.3
All types	263.5

[1] All of the acreage is productive-reserved.

Table 12. *Number of growing-stock trees on commercial forest land by diameter classes and by softwoods and hardwoods, Tennessee, 1961*

D.b.h. class (inches)	All species	Softwood	Hardwood
	Thousand trees		
1.0 — 2.9	4,056,900	526,100	3,530,800
3.0 — 4.9	1,077,590	240,600	836,990
5.0 — 6.9	490,830	114,210	376,620
7.0 — 8.9	273,840	56,060	217,780
9.0 — 10.9	164,820	31,120	133,700
11.0 — 12.9	87,160	11,660	75,500
13.0 — 14.9	49,330	6,430	42,900
15.0 — 16.9	23,640	2,660	20,980
17.0 — 18.9	12,910	1,190	11,720
19.0 and larger	14,670	910	13,760
All classes	6,251,690	990,940	5,260,750

Table 13. *Number of cull and salvable dead trees on commercial forest land by diameter groups and by softwoods and hardwoods, Tennessee, 1961*

D.b.h. class (inches)	Cull trees	Salvable dead trees
	– Thousand trees –	
Softwood:		
5.0 – 8.9	6,100	1,536
9.0 – 18.9	1,530	493
19.0 and larger	50	9
Total	7,680	2,038
Hardwood:		
5.0 – 10.9	218,760	1,162
11.0 – 18.9	50,220	531
19.0 and larger	9,060	119
Total	278,040	1,812
All species	285,720	3,850

Table 14. *Volume of timber on commercial forest land by class of timber and by softwoods and hardwoods, Tennessee, 1961*

Class of timber	All species	Softwood	Hardwood
	– – – Million cubic feet – – –		
Sawtimber trees:			
Sawlog portion	3,181.0	685.6	2,495.4
Upper stem portion	1,011.8	97.8	914.0
Total	4,192.8	783.4	3,409.4
Poletimber trees	3,016.6	452.6	2,564.0
All growing stock	7,209.4	1,236.0	5,973.4
Sound cull trees:			
Sawtimber-size	532.8	9.5	523.3
Poletimber-size	296.2	6.0	290.2
Total	829.0	15.5	813.5
Rotten cull trees:			
Sawtimber-size	526.5	2.3	524.2
Poletimber-size	138.8	1.7	137.1
Total	665.3	4.0	661.3
Salvable dead trees:			
Sawtimber-size	22.1	7.0	15.1
Poletimber-size	7.7	4.6	3.1
Total	29.8	11.6	18.2
All timber	8,733.5	1,267.1	7,466.4

Table 15. *Volume of growing stock and sawtimber on commercial forest land by ownership classes and by softwoods and hardwoods, Tennessee, 1961*

Ownership class	Growing stock			Sawtimber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	–Million cubic feet –			*– Million board feet –*		
Public:						
National forest	541.3	245.2	296.1	1,839.4	959.8	879.6
Other public	392.8	84.9	307.9	1,179.6	295.9	883.7
Total	934.1	330.1	604.0	3,019.0	1,255.7	1,763.3
Private:						
Forest industry	510.9	80.7	430.2	1,346.7	284.2	1,062.5
Farmer and misc. private	5,764.4	825.2	4,939.2	15,716.1	2,588.9	13,127.2
Total	6,275.3	905.9	5,369.4	17,062.8	2,873.1	14,189.7
All ownerships	7,209.4	1,236.0	5,973.4	20,081.8	4,128.8	15,953.0

Table 16. *Volume of growing stock and sawtimber on commercial forest land by stand-size classes and by softwoods and hardwoods, Tennessee, 1961*

Stand-size class	Growing stock			Sawtimber		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	–Million cubic feet –			*– Million board feet –*		
Sawtimber	4,759.4	857.9	3,901.5	16,854.3	3,536.4	13,317.9
Poletimber	2,007.3	288.1	1,719.2	2,450.7	443.0	2,007.7
Sapling and seedling	442.3	89.6	352.7	775.5	148.1	627.4
Nonstocked areas	.4	.4	...	1.3	1.3	...
All classes	7,209.4	1,236.0	5,973.4	20,081.8	4,128.8	15,953.0

Table 17. *Volume of growing stock on commercial forest land by species and diameter classes, Tennessee, 1961*

Species	Diameter class (inches at breast height)								
	All classes	5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0 and larger
	Million cubic feet								
Softwood:									
Shortleaf and loblolly pines	495.9	82.4	127.9	117.8	59.7	45.8	39.4	15.9	7.0
Other yellow pines	421.7	67.3	97.8	112.1	70.8	47.2	14.5	4.1	7.9
White pine	115.2	5.4	15.6	10.0	9.8	20.3	15.8	19.0	19.3
Hemlock	99.4	5.4	6.0	6.2	17.9	20.2	17.5	7.7	18.5
Cypress	37.8	.5	.9	.9	6.9	2.5	2.4	7.8	15.9
Other softwoods	66.0	23.5	19.9	13.0	5.4	3.8	.4	...	...
Total	1,236.0	184.5	268.1	260.0	170.5	139.8	90.0	54.5	68.6
Hardwoods:									
Select white oaks [1]	817.4	78.6	133.5	165.1	140.5	116.4	55.4	41.9	86.0
Select red oaks [2]	339.7	13.9	30.1	32.9	42.7	48.4	45.3	28.7	97.7
Other white oaks	726.7	72.2	126.0	143.8	106.0	80.3	76.6	31.2	90.6
Other red oaks	985.0	90.0	143.9	163.4	148.9	149.9	102.3	63.5	123.1
Hickory	830.6	88.3	129.2	171.8	139.8	111.7	65.0	39.3	85.5
Yellow birch	7.4	1.1	.8	...	.9	...	...	1.7	2.9
Hard maple	114.6	8.2	15.8	29.7	14.1	10.3	7.7	11.2	17.6
Soft maple	199.0	28.6	42.2	43.6	26.4	22.6	14.2	10.9	10.5
Beech	115.2	8.8	11.5	10.1	8.8	10.5	10.7	9.9	44.9
Sweetgum	229.5	18.5	37.2	40.6	30.9	31.8	25.3	14.6	30.6
Tupelo and blackgum	203.7	16.4	27.4	37.4	32.4	32.0	28.6	11.6	17.9
Ash	160.2	20.5	20.9	31.3	16.6	19.4	10.5	17.3	23.7
Cottonwood	64.4	.5	..	...	2.4	2.9	15.4	18.4	24.8
Basswood	45.3	3.4	6.8	7.4	10.6	1.4	5.0	4.8	5.9
Yellow-poplar	434.8	28.6	56.0	75.1	68.1	71.2	36.7	47.8	51.3
Black walnut	86.8	9.5	11.2	18.9	20.2	11.6	3.9	4.6	6.9
Other hardwoods	613.1	96.7	116.5	100.1	65.7	58.7	47.9	48.7	78.8
Total	5,973.4	583.8	909.0	1,071.2	875.0	779.1	550.5	406.1	798.7
All species	7,209.4	768.3	1,177.1	1,331.2	1,045.5	918.9	640.5	460.6	867.3

[1] Includes white, swamp chestnut, swamp white, and chinkapin oaks.
[2] Includes cherrybark, Shumard, and northern red oaks.

Table 18. *Volume of sawtimber on commercial forest land by species and diameter classes, Tennessee, 1961*

Species	Diameter class (inches at breast height)						
	All classes	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0 and larger
	Million board feet						
Softwood:							
Shortleaf and loblolly pines	1,486.0	538.5	317.9	265.6	230.2	92.6	41.2
Other yellow pines	1,279.7	510.8	369.7	253.0	82.3	22.5	41.4
White pine	542.1	39.6	49.7	117.7	98.5	117.5	119.1
Hemlock	497.3	20.7	94.4	110.1	106.9	45.5	119.7
Cypress	218.8	2.3	37.4	14.7	14.3	47.5	102.6
Other softwoods	104.9	56.6	26.5	19.3	2.5	...	...
Total	4,128.8	1,168.5	895.6	780.4	534.7	325.6	424.0
Hardwood:							
Select white oaks [1]	2,053.2	...	615.6	544.9	257.4	204.0	431.3
Select red oaks [2]	1,267.1	...	179.7	227.5	219.6	142.3	498.0
Other white oaks	1,745.3	...	451.1	362.5	355.5	147.4	428.8
Other red oaks	2,764.4	...	643.8	698.0	491.2	312.7	618.7
Hickory	1,998.4	...	600.4	502.0	301.2	185.0	409.8
Yellow birch	27.2	...	3.9	...	...	8.6	14.7
Hard maple	293.6	...	61.6	49.1	37.3	55.5	90.1
Soft maple	398.0	...	119.5	105.1	67.6	53.0	52.8
Beech	419.9	...	38.1	49.4	51.6	49.1	231.7
Sweetgum	627.6	...	136.3	147.5	120.5	71.7	151.6
Tupelo and blackgum	551.2	...	134.9	141.3	131.0	56.4	87.6
Ash	414.4	...	73.7	84.0	50.0	85.9	120.8
Cottonwood	321.1	...	10.2	13.1	77.1	94.3	126.4
Basswood	134.2	...	49.2	7.1	24.9	24.1	28.9
Yellow-poplar	1,310.6	...	295.9	337.9	180.0	234.2	262.6
Black walnut	218.0	...	88.1	55.4	18.1	21.7	34.7
Other hardwoods	1,408.8	...	279.2	275.4	228.2	238.4	387.6
Total	15,953.0	...	3,781.2	3,600.2	2,611.2	1,984.3	3,976.1
All species	20,081.8	1,168.5	4,676.8	4,380.6	3,145.9	2,309.9	4,400.1

[1] Includes white, swamp chestnut, swamp white, and chinkapin oaks.
[2] Includes cherrybark, Shumard, and northern red oaks.

Table 19. *Volume of sawtimber on commercial forest land by species and log grade, Tennessee, 1961*

Species	All grades	Grade 1 logs	Grade 2 logs	Grade 3 logs	Lower grade logs
	Million board feet				
Softwood:					
Yellow pines	2,765.7	...	242.3	1,029.5	1,493.9
White pine	542.1	...	12.4	187.4	342.3
Other softwoods	821.0	143.1	61.8	242.5	373.6
Total	4,128.8	143.1	316.5	1,459.4	2,209.8
Hardwood:					
Select white and red oaks	3,320.3	427.3	717.5	1,797.3	378.2
Other white and red oaks	4,509.7	474.1	882.2	2,454.0	699.4
Hickory	1,998.4	117.8	386.7	1,046.1	447.8
Hard maple	293.6	30.9	39.8	167.6	55.3
Sweetgum	627.6	45.5	132.4	323.1	126.6
Ash, black walnut, and black cherry	660.6	40.0	147.4	395.1	78.1
Yellow-poplar	1,310.6	144.4	252.6	589.9	323.7
Other hardwoods	3,232.2	265.3	840.9	1,702.4	423.6
Total	15,953.0	1,545.3	3,399.5	8,475.5	2,532.7
All species	20,081.8	1,688.4	3,716.0	9,934.9	4,742.5

Table 20. *Volume of salvable dead sawtimber-size trees on commercial forest land by softwoods and hardwoods, Tennessee, 1961*

Species group	Volume
	Million board feet
Softwood	34.8
Hardwood	71.1
All species	105.9

Table 21. *Net annual growth and cut of growing stock on commercial forest land by species, Tennessee, 1960*

Species	Net annual growth	Annual timber cut
	Million cubic feet	
Softwood:		
Yellow pines	49.0	37.8
Other softwoods	16.9	7.6
Total	65.9	45.4
Hardwood:		
Select white and red oaks	49.6	42.2
Other white and red oaks	73.5	59.4
Hickory	35.6	11.9
Yellow-poplar	18.6	7.1
Other hardwoods	78.9	41.7
Total	256.2	162.3
All species	322.1	207.7

Table 22. *Net annual growth and cut of growing stock on commercial forest land by ownership classes and by softwoods and hardwoods, Tennessee, 1960*

Ownership class	Net annual growth			Annual timber cut		
	All species	Softwood	Hardwood	All species	Softwood	Hardwood
	Million cubic feet					
Public	43.5	17.6	25.9	13.3	3.5	9.8
Forest industry	22.8	4.3	18.5	23.1	.8	22.3
Farmer and misc. private	255.8	44.0	211.8	171.3	41.1	130.2
All ownerships	322.1	65.9	256.2	207.7	45.4	162.3

Table 23. *Net annual growth and cut of sawtimber on commercial forest land by species, Tennessee, 1960*

Species	Net annual growth	Annual timber cut
	Million board feet	
Softwood:		
Yellow pines	166.2	135.9
Other softwoods	82.0	32.7
Total	248.2	168.6
Hardwood:		
Select white and red oaks	152.5	171.0
Other white and red oaks	207.0	215.0
Hickory	91.8	39.7
Yellow-poplar	60.2	24.4
Other hardwoods	221.0	160.7
Total	732.5	610.8
All species	980.7	779.4

Table 24. *Net annual growth and cut of sawtimber on commercial forest land by ownership classes and by softwoods and hardwoods, Tennessee, 1960*

Ownership class	Net annual growth			Annual timber cut		
	All species	Soft-wood	Hard-wood	All species	Soft-wood	Hard-wood
	Million board feet					
Public	156.5	75.5	81.0	51.4	15.8	35.6
Forest industry	65.9	17.1	48.8	89.3	2.5	86.8
Farmer and misc. private	758.3	155.6	602.7	638.7	150.3	488.4
All ownerships	980.7	248.2	732.5	779.4	168.6	610.8

Table 25. *Annual mortality of growing stock and sawtimber on commercial forest land by species, Tennessee, 1960*

Species	Growing stock	Saw-timber
	Million cubic feet	*Million board feet*
Softwood:		
Yellow pines	6.4	16.6
Other softwoods	2.3	8.2
Total	8.7	24.8
Hardwood:		
Select white and red oaks	8.6	23.2
Other white and red oaks	12.7	31.5
Hickory	6.2	13.9
Yellow-poplar	3.2	9.2
Other hardwoods	13.8	33.7
Total	44.5	111.5
All species	53.2	136.3

Table 26. *Annual mortality of growing stock and sawtimber on commercial forest land by ownership classes and by softwoods and hardwoods, Tennessee, 1960*

Ownership class	Growing stock			Sawtimber		
	All species	Soft-wood	Hard-wood	All species	Soft-wood	Hard-wood
	Million cubic feet			*Million board feet*		
Public	6.8	2.3	4.5	19.9	7.6	12.3
Forest industry	3.8	.6	3.2	9.1	1.7	7.4
Farmer and misc. private	42.6	5.8	36.8	107.3	15.5	91.8
All ownerships	53.2	8.7	44.5	136.3	24.8	111.5

Table 27. *Annual mortality of growing stock and sawtimber on commercial forest land by causes and by softwoods and hardwoods, Tennessee, 1960*

Cause of death	Growing stock			Sawtimber		
	All species	Soft-wood	Hard-wood	All species	Soft-wood	Hard-wood
	Million cubic feet			*Million board feet*		
Fire	1.9	0.3	1.6	2.5	...	2.5
Insects	2.0	2.0	...	8.1	8.1	...
Disease	.1	.1	...	.6	.6	...
Other	16.0	4.4	11.6	42.9	9.4	33.5
Unknown	33.2	1.9	31.3	82.2	6.7	75.5
All causes	53.2	8.7	44.5	136.3	24.8	111.5

Table 28. *Total output of timber products by product, by type of material used, and by softwoods and hardwoods, Tennessee, 1960*

Product and species group	Total output in standard units		Output from roundwood		Output from plant by-products (standard units)
	Unit	Number	Standard units	M cubic feet	
Sawlogs:					
Softwood	M bd. ft. [1]	156,939	156,939	27,150	...
Hardwood	M bd. ft. [1]	476,564	476,564	72,914	...
Total	M bd. ft. [1]	633,503	633,503	100,064	...
Veneer logs and bolts:					
Softwood	M bd. ft.	351	351	58	...
Hardwood	M bd. ft.	10,713	10,713	1,500	...
Total	M bd. ft.	11,064	11,064	1,558	...
Cooperage logs and bolts:					
Softwood	M bd. ft.	115	115	20	...
Hardwood	M bd. ft.	25,529	25,529	3,675	...
Total	M bd. ft.	25,644	25,644	3,695	...
Pulpwood:					
Softwood	Std. cords [2]	189,887	188,754	14,232	1,133
Hardwood	Std. cords [2]	171,891	164,668	12,811	7,223
Total	Std. cords [2]	361,778	353,422	27,043	8,356
Piling:					
Softwood	M linear ft.	483	483	309	...
Hardwood	M linear ft.	...	...	...	...
Total	M linear ft.	483	483	309	...
Poles:					
Softwood	M pieces	24	24	109	...
Hardwood	M pieces	...	...	...	...
Total	M pieces	24	24	109	...
Mine timbers (round):					
Softwood	M cu. ft.	169	169	169	...
Hardwood	M cu. ft.	1,286	1,286	1,286	...
Total	M cu. ft.	1,455	1,455	1,455	...
Misc. industrial wood: [3]					
Softwood	M cu. ft.	997	312	312	685
Hardwood	M cu. ft.	17,008	10,871	10,871	6,137
Total	M cu. ft.	18,005	11,183	11,183	6,822
Posts (round and split):					
Softwood	M pieces	2,310	2,310	1,593	...
Hardwood	M pieces	7,739	7,739	5,692	...
Total	M pieces	10,049	10,049	7,285	...
Fuelwood:					
Softwood	Std. cords	32,457	3,756	283	28,701
Hardwood	Std. cords	661,383	419,490	31,462	241,893
Total	Std. cords	693,840	423,246	31,745	270,594
All products:					
Softwood	M cu. ft.	...	...	44,235	...
Hardwood	M cu.ft.	...	...	140,211	...
Total	M cu. ft.	...	...	184,446	...

[1] International ¼-inch rule.
[2] Rough wood basis (for example, chips converted to equivalent standard cords).
[3] Includes hewn ties, chemical wood, handle stock, furniture and other dimension, shuttleblocks, and miscellaneous domestic use. Additionally, byproducts include material used for livestock bedding, mulch, etc.

Table 29. *Total output of roundwood products by source and by softwoods and hardwoods, Tennessee, 1960*

Source	All species	Softwood	Hardwood
	– – – Thousand cubic feet – – –		
Growing stock trees: [1]			
Sawtimber	121,760	30,909	90,851
Poletimber	42,540	11,577	30,963
Total	164,300	42,486	121,814
Cull trees [1]	5,534	16	5,518
Salvable dead trees [1]	4,299	183	4,116
Other sources [2]	10,313	1,550	8,763
All sources	184,446	44,235	140,211

[1] On commercial forest land.

[2] Includes noncommercial forest land, nonforest land such as fence rows, trees less than 5.0 inches in diameter, and treetops and limbs.

Table 30. *Annual timber cut from growing stock on commercial forest land by product and logging residues, and by softwoods and hardwoods, Tennessee, 1960*

Product and residues	All species	Softwood	Hardwood
	– – – Thousand cubic feet – – –		
Roundwood products:			
Sawlogs	98,321	26,837	71,484
Veneer logs and bolts	1,547	58	1,489
Cooperage logs and bolts	3,645	19	3,626
Pulpwood	24,221	13,024	11,197
Piling	310	310	. . .
Poles	109	109	. . .
Mine timbers	1,455	169	1,286
Miscellaneous industrial wood [1]	9,263	306	8,957
Posts	6,802	1,485	5,317
Fuelwood	18,627	169	18,458
All products	164,300	42,486	121,814
Logging residues	43,446	2,886	40,560
Timber cut	207,746	45,372	162,374

[1] Includes 714 M cu. ft. of miscellaneous farm products.

Table 31. *Annual timber cut from live sawtimber on commercial forest land by product and logging residues, and by softwoods and hardwoods, Tennessee, 1960*

Product and residues	All species	Softwood	Hardwood
	– – Thousand board feet – –		
Roundwood products:			
Sawlogs	584,397	145,482	438,915
Veneer logs and bolts	11,030	328	10,702
Cooperage logs and bolts	24,434	107	24,327
Pulpwood	44,957	16,799	28,158
Piling	1,686	1,686	. . .
Poles	594	594	. . .
Mine timbers	1,784	79	1,705
Miscellaneous industrial wood	30,774	166	30,608
Posts	3,575	185	3,390
Fuelwood	27,686	. . .	27,686
All products	730,917	165,426	565,491
Logging residues	48,519	3,132	45,387
Timber cut	779,436	168,558	610,878

Table 32. *Volume of plant residues by industrial source and type of residue, and by softwoods and hardwoods, Tennessee, 1960*

Industrial source	All species			Softwood			Hardwood		
	Total	Coarse [1]	Fine [2]	Total	Coarse [1]	Fine [2]	Total	Coarse [1]	Fine [2]
	Thousand cubic feet								
Lumber industry	26,984	11,092	15,892	10,219	5,664	4,555	16,765	5,428	11,337
Veneer and plywood industry	45	16	29	17	16	1	28	. . .	28
Other primary industries	1,938	411	1,527	18	7	11	1,920	404	1,516
All industries	28,967	11,519	17,448	10,254	5,687	4,567	18,713	5,832	12,881

[1] Unused material suitable for chipping, such as slabs, edgings, and veneer cores.
[2] Unused material not suitable for chipping, such as sawdust and shavings.

Table 33. *Timber growth projections, Tennessee, 1961 to 1991* [1]

Period	Assumed cut			Projected growth		
	All species	Soft-wood	Hard-wood	All species	Soft-wood	Hard-wood
	GROWING STOCK					
	Thousand cubic feet					
1961 (year of inventory)	207,700	45,400	162,300	322,100	65,900	256,200
1971 (plus 10 years)	215,600	50,400	165,200	363,200	75,800	287,400
1981 (plus 20 years)	230,200	59,800	170,400	425,900	85,700	340,200
1991 (plus 30 years)	252,700	71,800	180,900	506,900	95,900	411,000
	SAWTIMBER					
	Thousand board feet					
1961 (year of inventory)	779,400	168,600	610,800	980,700	248,200	732,500
1971 (plus 10 years)	813,300	183,700	629,600	1,067,400	293,400	774,000
1981 (plus 20 years)	876,400	211,900	664,500	1,177,500	361,700	815,800
1991 (plus 30 years)	947,800	240,800	707,000	1,296,900	445,200	851,700

[1] Based on assumptions that timber output in the United States and Tennessee will increase with anticipated gains in population and gross national product; that industrial wood products will largely maintain their relative position in the national economy; and that forestry progress will continue at the rate indicated by recent trends.

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